THE CCI TK-1 DIGITAL READOUT

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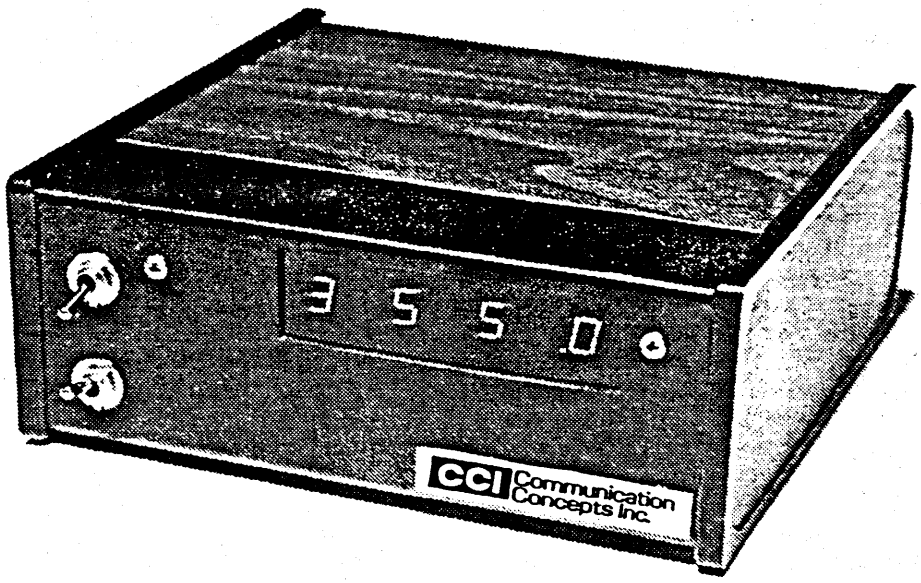

Some among us are properly enthusiastic about the exotic radio receivers of the vacuum-tube era. Enthusiasm is muted though when thoughts turn to frequency determination with analog-dial receivers. Who among us remembers happy hours spent with bandspread logging scale, graph paper and pencil? Maybe one or two?

Some old receivers, like the Collins and Drake products, owe part of their appeal to their high degree of readout accuracy. Other oldies with inadequate analog dials would be more popular today if one could read the frequencies better. That of course is where the outboard electronic digital readout comes in. These devices were the subject of much interest a decade or two ago when a most DXers and SWLs were still struggling with analog dials. Now the subject is of interest to those of us who cling to those wonderful oldies.

The TK-1 is one digital readout that is still around. Marketed by Torrestronics back in the mid-Eighties, it has been made for the last four years by Communication Concepts Inc. of Ohio. This company makes components such as RF amplifier modules for the ham radio market.

As a satisfied buyer of three TK-1's in the last two years, I have noted the slow increase in serial numbers. When I asked someone at their office recently whether CCI was going to continue making the product, she said, "Yes, there are always old-timers around who like using it."

DIGITAL READOUT BASICS

Digital frequency readout is possible because most receivers have a high-frequency oscillator with a measurable frequency output that varies in a set relationship with the frequency the receiver is tuned to. The difference between the two frequencies is the intermediate frequency of the receiver at that stage in its circuitry. The oscillator's frequency may track either higher or lower than the received radio frequency, depending on the design choice.

If, for example, the intermediate frequency is 455 kHz, the oscillator is on the high side and the receiver is tuned to 4800 kHz, the oscillator's frequency will be the sum of the two, 5255 kHz. If the oscillator is on the low side, its frequency will be the difference, 4345 kHz. A person who has a digital frequency counter can couple its input to the receiver oscillator circuit and read the oscillator frequency. This procedure means though that the listener has to make a tedious subtraction or addition for every station frequency determination. (Might as well go back to a chart!) The first essential feature in any digital readout is the capacity to permit the user to program into it a preset figure, equal to the intermediate frequency. This figure will be the constant addition to or subtraction from the oscillator frequency count.

One possible variant to allow for in the design is that the receiver may use a second intermediate frequency on one or more bands, necessitating in that case a different addition or subtraction. Less common is the situation where the oscillator varies inversely, that is, its frequency decreases as the radio frequency is tuned higher.

The commercial receiver manufacturer can take these variations into account in his design; the listener need never be aware of all that his receiver's frequency readout circuit is automatically doing. The home builder can to do the same, but at a cost. In 1975 I built from a magazine article a full frequency counter for an HQ-180A. Methods have been somewhat simplified since, but my readout was half as big as the receiver and cost more than half as much. The two were linked by seven coaxial cables. I thought I was on the cutting edge of technology. No more guessing!

TK-1 DISPLAY AND PRESET METHOD

A digital frequency readout designer has to weigh the costs in deciding how many variables to allow for. Possible steps for simplicity and cost reduction are omitting the megahertz digits from the readout and providing for an add-only preset rather than a subtraction preset too. This is what the designer of the TK-1 did. The display is of four digits, giving the frequency to tenths of a kilohertz but omitting any megahertz digit. The listener can glance at the receiver analog dial for the megahertz figure and read the rest of the frequency from the digital readout. If a subtraction preset is called for, its arithmetical complement is programmed in as an addition instead. The method of determining the presets is logical and well covered in the TK-1 operating manual.

THE TK-1 UNIT

The TK-1 readout comes fully assembled. It is in a two-piece metal enclosure measuring 6.4 in. W. x 2.4 in. H. x 6.0 in. D. In addition to the display, the front panel has two controls, a toggle switch for the power on/off and another for choosing either one of two preset additions which are labeled A and B. On the back are the AC cord, two RCA jacks in parallel for inputs from two receivers, and a third toggle switch. This last is for setting in reverse the direction of the count for the few receivers in which the receiver oscillator frequency decreases as the received frequency is tuned higher.

DISPLAY

The TK-1 reads out frequencies to the nearest 100 Hertz, showing four digits. The first three digits are red, while the last, the decimal fraction of a kHz, is yellow. Their height of .3" makes for excellent visibility. In the latest models, the decimal fraction digit is smaller.

INSTRUCTIONS

The TK-1 comes with an operating manual and a separate guide for mating the readout to a receiver. In the latest manual I have, step-by-step home-assembly instructions take up almost half of its 22 pages. The construction kit, however, is no longer available. The remainder of the book explains circuit principles, programming the presets, re-calibration and trouble-shooting.

In the 30-page mating guide are instructions for connecting any one of about two dozen analog receivers and transceivers of the last thirty years. Receivers specifically covered include the Collins 'S' line, the Drake SPR4 and R4 series, the Hammarlund SP-600 and HQ-180(A) series, the National HRO-60 and the Yaesu FRG-7. In addition, there is a special mating circuit suggestion for "very old receivers" which include the Hammarlund HQ-129X, and the Hallicrafters SX-28 and SX-42.

FREQUENCY PRESETS

The TK-1 can be preset with two constants for addition, each selectable by the user by flicking the toggle switch on the front of the TK-1. A preset addition is displayed while the unit is turned on and is not receiving input from a receiver. At the moment I make use of two presets for each of a Hallicrafters SX-42, a Hammarlund SP-600J and a Hammarlund HQ-180C. With the first, it is a matter of the highest SW band having the oscillator on the low side, while with the other two the higher bands have a higher i.f.

Each of the readout's four digital display units has a corresponding internal surface-mounted eight-position DIP switch which is used for the presetting of an addition digit. On each switch, the even-numbered positions are set in a particular on/off configuration to establish a digit for addition when the external toggle switch is in the "A" position, while the odd-numbered ones similarly establish the digit added when the toggle is in the "B" position. Removing two screws allows access to the DIP switches.

SENSITIVITY

The stated sensitivity is better than 5 mV. RMS at 4.3 MHz and 25 mV. RMS at 50 MHz. It will operate at a specified sensitivity from 100 kHz to 50 MHz, with reduced sensitivity a little beyond those extremes. The maximum signal strength permitted is 3 volts over the lower part of the BC/SW range, dropping to 1 volt toward the top end. CCI provides in the mating instructions a graph of the unit's maximum and minimum sensitivity limits across the frequency spectrum.

FREQUENCY STABILITY

Because the unit is totally enclosed to minimize RF radiation, there is a warm-up temperature rise and a consequent frequency drift. The maker states, however, that the absolute readout accuracy during the first hour is within 200 Hz at 21 MHz, with minimal further change. The drift at lower frequencies is commensurately less. I find the drift in my units, by rough measurement against WWV on 20 MHz, to be about 200 Hz in the first couple of hours. There is no noticeable frequency change later.

MATING RECEIVER AND TK-1

The link from the TK-1 must be shielded r.f. coax, such as either RG-58 or the smaller RG-174, connected to the receiver chassis by a connector such as a RCA plug to a jack. A further coax run inside the receiver is made to a point near the receiver's variable oscillator. The mating instructions, while they deal with numerous individual receivers, come down in most cases to a single means of connection to the receiver circuit. One lead of a small disk capacitor, in a range of 22 pf. to 68 pf., is connected to a circuit point in the oscillator/mixer area, and the other end is joined to the center wire of the coax cable. For lighter coupling, one can twist a short insulated hook-up wire several times around the capacitor lead and connect to the coax center wire.

This final connection to the receiver is a matter of possible difficulty from the performance standpoint. Linking any new component to or near the oscillator/mixer circuits may well add a new fixed capacitance which will lower the frequency tuned to and upset the degree of tracking between stages. The frequency may be lowered by as much as 100 to 200 kHz. The higher the coupling capacitance, the greater this negative effect. A touch-up of the receiver alignment can largely restore dial calibration etc. at lower frequencies, but oscillator-stage core and trimmer capacitor adjustment limitations may not permit full corrections, especially at higher frequencies.

On the other hand, obtaining a desirable low capacitance through very light coupling can mean a weaker oscillator signal to the counter that is not adequate to trigger a readout. The display digits will vary randomly or just stay at the resting preset addition readout. This often manifests itself first at the high SW end, i.e. over 20 MHz, and then at the low BC end. Blind spots though can occasionally develop in a receiver band. Substituting another oscillator tube may make a difference. With any one of my three receivers connected, a scope shows a high oscillator voltage amplitude into the TK-1 at frequencies up to about 5 MHz. At higher frequencies there is a gradual drop off down to near 10 mV. which is borderline for reading the high SW frequencies. Anyone who is interested only in tropical band frequency displays may need only very light coupling for satisfactory results.

For receivers that give rise to serious match-up problems, even to the point of oscillator failure through loading, the mating instructions booklet shows a schematic and p.c. template for a small buffer circuit with a quasi-emitter follower. This very small unit is installed in the host receiver. The 6 to 12 V.AC or DC power requirement can be tapped from the 6.3 V.AC filament supply in most tube receivers.

Nothing is predictable in this area. My newest TK-1 recently appeared to be insensitive because it was not fully responding to what has been my most powerful receiver for oscillator output. At the same time, my most sensitive TK-1 was becoming unresponsive on certain frequencies while linked to my weakest receiver. I changed the partners, expecting one good match to result, but the weak with the insensitive now perform together just as well as the supposedly stronger pair.

BIRDIES AND INTERFERENCE

Under this title, CCI says birdies can occur outside the ham bands. Usually, I take birdies to mean rather innocuous heterodynes. Some of the ones here though, when not dealt with, can be large pulsing signals more than 50 kHz wide. Where they will appear depends on the degree of receiver and antenna shielding, line cord filtering and the receiver's i.f configuration. Every receiver and readout pair seem to produce different results. The last unit I bought is, for whatever reason, the quietest. One of the best steps to take is to put a few ferrite chokes on the readout's line cord and coax cable, both at the points of exit from the readout enclosure. I use the type sold by vendors like MFJ and Radio Shack. When dealing with this problem, the use of RG-174 coax may be better than RG-58 with equivalent shielding. More turns of the smaller diameter RG-174 can be wound around the ferrite units, thus affording greater absorption of interfering signals. With a little effort, most interference can be eliminated.

USE AS A COUNTER

Other radio-frequency equipment with analog displays can perform better when a TK-1 is attached and used as a counter. I have two signal generators which benefit in this way. Although the TK-1 with its frequency resolution to 100 Hz is not up to the most exacting requirements, it's still a lot better than an analog dial.

CONCLUSION

I am not aware of any other units in this price range that are available to hobbyists. The TK-1's performance satisfies me, notwithstanding the fact there may be mating problems with certain receivers. To my mind, adding an accurate frequency readout capability to an analog-dial receiver can often convert the latter from a museum piece into useful equipment.

At present, the TK-1 is available ready to use for $149.95 plus shipping from Communication Concepts Inc., 508 Millstone Drive, Beavercreek, Ohio 45434-5840. (513)220-9677 or (513)426-8600. Fax (513)429-3811.